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ABSTRACT

A study was conducted to determine the validity and viability of a Southeastern Pennsylvania biomedical equipment technician program at the community college level. The results of a survey questionnaire, site visits, and interviews with administrators of existing health care facilities and ongoing biomedical curricula, indicated the following: (1) biomedical equipment technician (BMET) is an emerging occupation in the greater Philadelphia region; (2) a BMET program could be an option to an existing electronics program; and (3) a BMET program could be offered in a more cost effective manner by coordinated programming with several institutions; the need for replicating high initial cost facilities would be eliminated and only minor changes in existing electronics curricula would be required of the institutions forming a consortium in BMET. (A copy of the survey form is included in the appendices.) (JH)

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FINAL REPORT

INVESTIGATION TO DETERMINE THE VALIDITY AND VIABILITY OF A REGIONAL BIOMEDICAL EQUIPMENT TECHNICIAN PROGRAM AT THE COMMUNITY COLLEGE LEVEL

(Project #93-9019)

DR. WALTER F. MRUK AND MR. DOUGLAS E. FENWICK

COMMUNITY COLLEGE OF PHILADELPHIA

PHILADELPHIA, PA.

JUNE 30, 1979

PENNSYLVANIA DEPARTMENT OF EDUCATION

BUREAU OF VOCATIONAL EDUCATION

RESEARCH COORDINATING UNIT

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ABSTRACT

Contract #93-9019: To determine the validity and viability of a Southeastern Pennsylvania Biomedical Equipment Technician Program at the Community College level.

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PURPOSE:

The purpose of this project is threefold:

1. To determine if the Biomedical Equipment Technician is an emerging occupation in the greater Philadelphia Region;
2. To determine if a Biomedical Equipment Technician Program could be an option to an existing Electronics Program;
3. To determine if a Biomedical Equipment Technician Program could be offered in a more cost-effective manner by coordinated programming with several institutions.

OBJECTIVES:

To conduct a study that will provide pertinent data for answering the following questions:

1. Is the Biomedical Equipment Technician an emerging occupation in the greater Philadelphia Region?
2. Could a Biomedical Equipment Technician Program be an option to an existing Electronics Program?
3. Could a Biomedical Equipment Technician Program be offered in a more cost-effective manner by coordinated programming with several institutions?

OUTCOMES:

The results of the investigation conducted by the Community College of Philadelphia indicated that:

1. Biomedical Equipment Technician (BMET) is an emerging occupation in the greater Philadelphia Region.
2. A Biomedical Equipment Technician (BMET) Program can be an option to an existing Electronics Program under this restriction: An existing Electronics Program will probably offer limited educational experience based on the fact that, in general, Biomedical Equipment and associated training and clinical experience are high-initial-cost.
3. A "BMET" Program could be offered in a more cost-effective manner by coordinated programming with several institutions because the need for replicating high-initial-cost facilities would be eliminated and only minor changes, if any, in existing Electronics Curricula would be required of the institutions forming a consortium in BMET.

SECTION I - Is the Biomedical Equipment Technician an emerging occupation in the Southeastern Region of Pennsylvania? To address this query, a data base consisting of these elements of information was developed:

a) Definition of a Biomedical Equipment Technician.

Sources:

- o U. S. Department of Occupational Titles, Washington, D. C.
- o Association for the Advancement of Medical Instrumentation (AAMI)
- o Technical Education Resources Center, Boston, Mass.
- o Pennsylvania Department of Education, Coordinating Unit for Vocational Education, Harrisburg, Pa.
- o Journal of Clinical Engineering
- o Interviews with Administrators of ongoing BMET Programs
- o Interviews with Administrators employing BMET's
- o Chronicle Guidance Publications
- o Technical Education Reporter

  Arthur D. Little - '70', Boston Study
- o Miscellaneous

b) The duties, functions, and responsibilities of a BMET

Sources: IBID

c) The BMET job market

Sources: IBID

- o Community College of Philadelphia

  Survey questionnaire
- o Interviews with potential and actual employers of BMET's

d) Possible constraints on a BMET Program concerning handicapped persons

e) Data Compilation

f) Analysis

g) Conclusion; Restrictions

SECTION I - General Findings

a) The Biomedical Equipment Technician

An assessment of all the sources cited for a definition of a Biomedical Equipment Technician converges into an operational description such as:

> "An individual who possesses and utilizes a working knowledge of the safe clinical applications, operations, and maintenance of Biomedical apparatus."

b) The duties, functions and responsibilities of a BMET (re Biomedical apparatus)

- o Inspection
- o Evaluation
- o Operation
- o Supervision
- o Calibration
- o Installation
- o Safety checks (electrical, mechanical, etc.)
- o Instruction
- o Documentation of system performance (log books)
- o Maintenance; trouble-shooting; conduct preventive procedures and document same
- o Repair

c) The BMET job market

Based on the results of the Community College of Philadelphia's survey questionnaire, site visits, and interviews with administrators of existing health care facilities and ongoing Biomedical Curricula, the job market for BMET (Biomedical Equipment Technician) is somewhat more restrictive than for a BMET (Biomedical Electronics Technician). Apparently, the word Electronics implies a wider adaptability of acquired skills than does the word Equipment. It is therefore recommended that the abbreviation, BMET, stand for Biomedical Electronics Technician and that the program be so labeled. The results of the questionnaire

c) The BMET job market (con't)

(initial mailing to health care facilities, maintenance firms and equipment manufacturers) indicate that the 43 respondents (a 37% response) expect to hire an average of 30 BMET's per year for the next three years.

The Administrators of the BMET Programs at the three sites visited acknowledged that each member of their graduating class has job offers as a BMET (class-size average equal to 8; 6 to 8 per graduating class have BMET jobs), or with electronics firms (implying further support of the higher acceptance of the BMET title as Biomedical Electronics Technician). The twenty-three respondents currently employing BMET's employ an average of 2.1 (total = 50). None of the respondents anticipates terminating any BMET positions through 1983. Interestingly, the number of turnovers is negligible (a total of eight) according to the respondents currently employing BMET's. One interpretation of this response may be that BMET's are a dedicated lot who enjoy high job satisfaction. The anticipated rate of pay for BMET's ranges from an average of $6.51 to $7.86 per hour; yet, starting salaries as high as $23,000/annum were reported. Twenty-eight of the respondents said they would consider employing BMET graduates from a program implemented at the community college level in Southeastern Pennsylvania.

d) Possible Constraints on a BMET Program

The needs of handicapped persons who would wish to enter this curriculum are of concern. Developments in "mainstreaming" lend substance to these concerns. The success of the Springfield Technical Community College (S.T.C.C. - Springfield, Mass.) BMET Program is due in large measure to Ross Higgins, a quadraplegic, who attended and completed the BMET Program at S.T.C.C. Fortunately, most

d) Possible Constraints on a BMET Program (con't)

architectural barriers had been eliminated prior to Mr. Higgin's matriculation at S. T. C. C., and interestingly, the laboratory benches have all been made table-height size (30"). Not only is this alteration favorable to the handicapped, but also tends to make the laboratory experience more intimate and personalized for all participants.

Such architectural considerations also impact on the size of lecture, laboratory, and/or seminar spaces. If mainstreaming is to be accommodated, it is not too early to be concerned with the entire spectrum of implications, such as curriculum modifications, if any, building or space allocations and design, and the job market. Obviously, the job market for the handicapped person will depend on the type of handicap and the specific job requirement. *

* "Educating The Handicapped in Biomedical Instrumentation," Rosenbrier, Technical Education Reporter, May/June '74. (See Appendix II)

SECTION II - Could a Biomedical Equipment Technician be an option to an existing Electronics Program?

Rationale:

a) Document the knowledge, skills, and capabilities required of a BMET to fulfill the general job description (See Section I).

b) Document the materials, courses, training and experiences offered by "typical" existing Electronics Programs at the Community College level.

c) Compare these two documentations.

d) Summarize inputs from site visits (See Appendix I - Compilation of Summary Memoranda on Site Visits).

e) Conclusion; Restrictions.

SECTION II - General Findings

a) The knowledge, skills and capabilities required of a BMET to fulfill the general job description

Although one is admonished to exercise caution in defining the job description of BMET (TERC)* certain minimal levels of knowledge, skills and capabilities specify a floor common to all BMET's:

1. Knowledge: Basic Electronics, Mathematics, Physics, Chemistry, Physiology
2. Skills: Communications, written and oral; Articulation with medical professionals
3. Capabilities: Sufficient maturity to arrive at sound judgment on electrical safety, instrumentation systems integrity; realization that BMET is an ongoing learning process.

b) The content of a typical existing Electronics Program at the community college level

Core curricula of several ongoing community-college-level Electronics Programs include courses covering material in:

- o D. C. Circuits
- o A. C. Circuits
- o Circuit Theory, Active Components
- o Mathematics
- o Physics
- o Chemistry
- o Communications

The job market for the graduates of such Electronics Programs generally requires skills in the analysis of circuits operation rather than in the creation or design of electronics circuits which nowadays tend towards relatively high sophistication; i. e., beyond the training level offered at the AAS Degree level.

*Biomedical Equipment Technology, Technical Education Research Centers Cambridge, Mass. 1 - '75.

SECTION II - General Findings (con't)

c) Comparison of items (a) and (b)

It would seem that the difference between the knowledge, skills and capabilities levels required of a BMET and training afforded by a "typical" Electronics Program is virtually nil, except for two requirements:

The BMET is concerned with human health, and the interface of modern Technology with human physiology which entails considerable interpersonal behavior.

The specialty items in the milieu of a BMET are high-initial-cost and are therefore usually not readily available in the "typical" Electronics Programs; consequently, the training of a BMET demands more than that generally afforded via a typical Electronics Program. For example, interpersonal relationships in a medico-technological environment are better developed via clinical experience in situ.

The high-cost specialty items for laboratory training (in trouble-shooting, operation, etc.) which would normally burden an ongoing Electronics Program in funding as well as low-use duty cycling for but a few students, can be justified by the formation of a central, or magnet, school and a consortium of regional community colleges (See Appendix I, Compilation of Site Visits Memos)*.

d) (See Appendix I)

e) Conclusion, Restrictions

Although existing typical Electronics Programs address the majority of training experience required for developing the BMET, the absence of the medical environment (clinical experience) and the high-initial-cost biomedical instrumentation routinely encountered in the work-world of the BMET put strains on typical Electronics Programs which may make graduates of such programs less attractive to the health care delivery professions.

*J. Baker - Monroe County College, Rochester, N. Y.
John Schwartzman - Catonsville County Community College, Md.
Ken DuPont - Springfield Tech. Community College, Springfield, Mass.
Phil Katz - Jefferson University Hospital, Curtis Bldg., Phila., Pa.
John Gesink - Penn State Commonwealth Extension, Wilkes-Barre, Pa.

SECTION III

Could a BMET program be offered in a more cost-effective manner by coordinated programming among several institutions?

(See next page for General Findings)

SECTION III - General Findings

From Section II, it seems to follow that a consortium offers the potential BMET (as well as health care delivery systems and the members of the consortium) these advantages and/or options:

1) Matriculation at a community college of his choice;
2) An additional career offering (option) for a given community college with a minimum, if any, of course adjustments, or revisions;
3) The opportunity for a more extensive training in BMET through exposure to students from different training backgrounds;
4) The accessibility to a broad spectrum of instrumentation and devices not usually available at a single community college;
5) The availability of prescribed clinical experience;
6) A focused job-campaign-skills development seminar;
7) Computer-managed instruction;
8) Computer-assisted instruction;
9) Accessibility to Clinical Facilities offering a broad spectrum of experiences usually unavailable at a local facility;
10) A cost-effective program.

Items (7) and (8) bear further exploration. The flow diagrams included (on pages 15 & 16) represent an instructional pattern which can avail the student of virtually 14 hours-per-day accessibility to the instructional materials and is a departure from conventional instructional modes.
To illustrate:

A student in the magnet school BMET Program would join the program after completing his first three semesters of study and training at his parent college.

Upon entering the program, he begins the 1st week's work defined explicitly by the instructional objectives which must be achieved by at least the end of the first week (at a competence level defined by either or both, criterion or norm-referenced performance).

At the completion of the 1st week's evaluation, the student will be either advanced to the second week's objectives, or remediated for the 1st week's work. The number of times that the student will be processed through the remediation shunt will be determined by the Consortium Advisory Committee made up of the member colleges of the Consortium. The Consortium Advisory Committee will also set the weekly objectives.

The flow diagrams imply a flexible process even among students entering the program on the same day since each student should progress at his own pace.

After completing the 1st week's work, the success of the student will advance him to the 2nd week's work with or without enrichment. It is only after the first (or subsequent) week's evaluation that the Enrichment Shunt becomes available to a student.

The process continues until all the course objectives have been achieved. Following the didactic part of the program is the Clinical-Experience, Summary (joint) Evaluation, and Return-to-Parent College.

BMET Magnet School Operating Rationale

The magnet school would accept students for BMET who meet a set of requirements agreed upon by the consortium and its Consortium Advisory Committee.

Students entering the program would be expected to have a background developed by the courses listed earlier.

The magnet school would be scheduled for the fourth semester of a typical 4 semester AAS degreed technology curriculum and would extend throughout the summer to accommodate all the students undergoing the program, their remediation requirements, and their clinical experience requirements. This curriculum, as depicted by enclosed flow diagrams, will be open-ended and computer-managed, with computer-assisted instruction available to the students on an extended-time basis. Students will proceed at their own pace. Evaluations of each week's specific requirements will serve as the basis for assessment of achievement and direction for future learning activities.

Instructor inputs will be available on a continuing basis (lectures, evaluations, etc.), and documented record-keeping will be under instructor supervision via the computer.

Clinical experience will extend over a continual time frame of approximately 10 weeks and will be arranged for by the magnet school.

At the successful completion of the course at the magnet school, appropriate documentation will be issued to the parent college of the student, qualifying him as having successfully completed this part of the requirements for graduation from his parent college. (Details will be worked out at the college administration level; e.g. dean or designate).

PROPOSED

Primary courses; i.e., courses that could be taught by member schools at their respective colleges:

BMET Magnet School Operating Rationale (con't)

PROPOSED

Specific Electrical Courses (or equiv.)	D. C. circuits
	A. C. circuits
	Transistors/circuits
	Digital (computer) circuits
Supportive Courses (or equiv.)	Physics
	Chemistry
	Physiology
	Anatomy
	Mathematics (algebra and right-triangled trigonometry.)
	Communications Skills

Initializing Exam -- Administered upon arrival for normalization of student's development in order to assist the student in placing him appropriately in the program.

Materials that would probably be formulated into a viable curriculum at a magnet school:

Medical Terminology

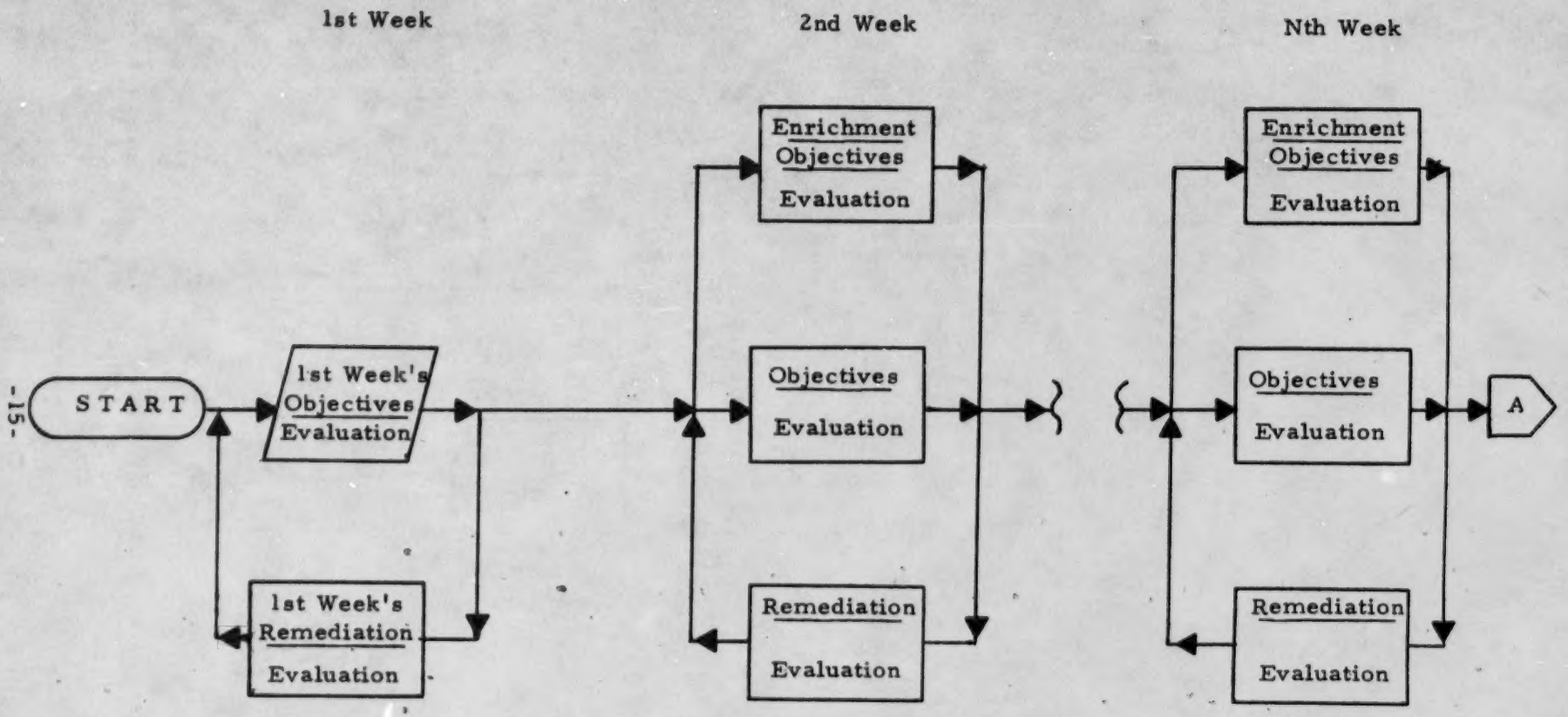
Physiological Measurements & Transducers

Electrical Hazards & Safety

Trouble-Shooting Medical Instrumentation Systems

Development of day-by-day skills; Interpersonal Relationships

Clinical work assignments and experience with medical professionals



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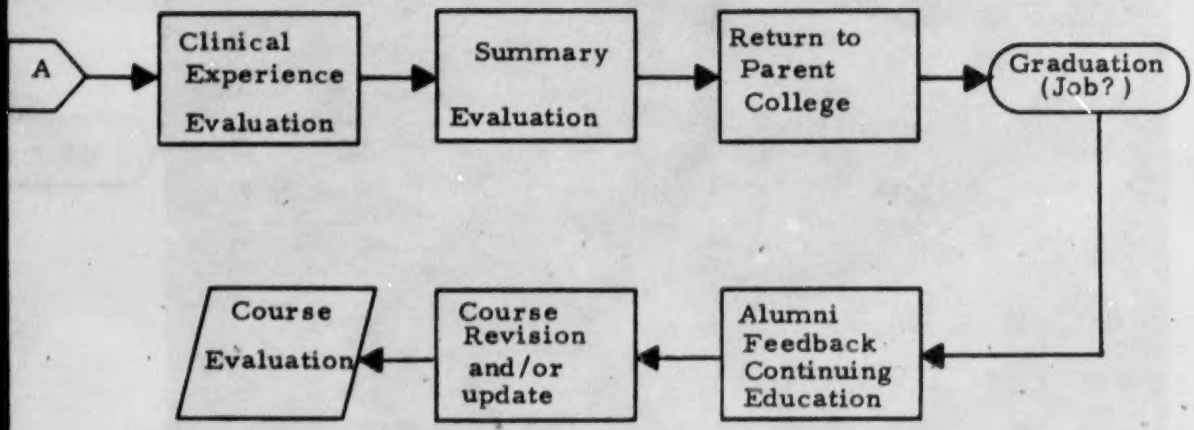
(POSSIBLE) TYPICAL BMET MAGNET-SCHOOL SEQUENCING

Page 1 of 2 Pages



(con't)
Page 2 of 2 pages

PROCEDURES

The following outlines the steps and time period in which the project was carried out.

FIRST STEP (April 1 - 30) Documentation of Biomedical Equipment Technician as an emerging occupation. Sources of data included:

1. A review of the literature
2. A telephone survey of five programs

SECOND STEP (April 1 - 30) Curriculum materials for Biomedical Equipment Technician and Electronics Technician were analyzed and compared for relevance. (Information obtained from institutions, organizations, and persons actively interested in Biomedical Electronics).

THIRD STEP (April 1 - 30) A program feasibility survey form for Biomedical Equipment Technician was developed. The survey form was designed to establish the existence of employment opportunities, salary levels, and appropriateness of proposed topical offerings.

FOURTH STEP (April 1 - May 31) Site visits were made to three existing Biomedical Equipment Technician Programs. A summary report was prepared for each visit.

FIFTH STEP (April 1 - May 31) Site visits were made to several local hospitals and industries making Biomedical Equipment. A summary report was prepared for each visit.

SIXTH STEP (May 1) A meeting was held to explore coordinated programming with other community colleges. Participation was sought from community colleges located primarily in Southeastern Pennsylvania. The meeting included a review and reaction to materials developed in steps one through five.

PROCEDURES (con't)

SEVENTH STEP (May 1 - 7) Refinement of program feasibility survey form.

EIGHTH STEP (May 8) Mailing of program feasibility survey form.

NINETH STEP (June 21) Summary of program feasibility survey forms and preparation of final report.

TENTH STEP (June 26) A second meeting was held to explore coordinated programming with other community colleges.

RECOMMENDATIONS:

Based on the second (final June 28, 1979) meeting, these substantive and procedural items were agreed upon:

1) That Biomedical Electronics Technology (BMET) is a viable career program in Southeastern Pennsylvania at the community college level.
2) That the interested community colleges acknowledge, in writing, their intent to participate in the further investigation of the development of a BMET consortium.
3) Each participating school will teach its Electronics Program and offer BMET as a 4th (and 5th or summer) semester option.
4) That there be unity on the suggested curriculum at the magnet school by the members of the consortium.
5) That the Magnet School would not serve as an evaluator of the incoming students for admission.
6) That a document will be prepared, at this working level, by those community colleges interested in the consortium for presentation to their respective administrations to insure full and complete cooperation for success of the BMET Program.
7) That the document produced as a result of item (6) would address a proposed working model including such consideration as:
   a) Student matriculation
   b) Methods for enabling the student to meet and satisfy "weekly" course objectives
   c) Travel and time constraints affecting item (b). (Open-ended curriculum within the calendar week).
   d) Transportation
   e) Fees-and-loans reciprocity agreements

RECOMMENDATIONS: (con't)

Therefore, it is recommended that further work be undertaken:

1) To develop a working document specifying how the BMET consortium can be effected administratively among the probable members of the consortium.
2) To develop a working document specifying the BMET curriculum to the level of the measurable behavioral objective, including the laboratory apparatus and equipment required.
3) To develop a working document specifying how the clinical experiences for the BMET will be effected.
4) To develop a working document specifying the space, its distribution, and occupancy to launch the BMET consortium.
5) To develop a working document and the necessary resources to market the BMET graduate to enable the program to become self-sustaining as early as possible.

INTER-OFFICE CORRESPONDENCE

TO: Dr. Pietak, Tom Hawk, and Dr. Oates

DATE: May 22, 1979

FROM: Dr. Mruk

SUBJECT: Site-visit to Monroe County Community College, Rochester, N. Y., re BMET Special Project #7750

Doug Fenwick and I visited with Mr. Joseph Baker and Mr. Les Laskowski of Monroe County Community College. Mr. Laskowski is responsible for the operation of the BMET Program, while Mr. Baker's responsibilities include both the Electronics and BMET Programs. In essence, the BMET program is a subset of the Electronics Program. The BMET Program is based on the core of the Electronics Program and introduces the student to the specialty as an "option."

The BMET laboratories exhibited a rather wide mix of basic biophysical measurement instrumentation, the rationale being that such instrumentation would be representative of a methodology well entrenched in the biomedical field and would not be expected to change in fundamental concept as might be expected of other more esoteric instrumentation.

Mr. Laskowski circumvents the more cost-intensive instrumentation by setting-up field experience encounters at hospitals and other health care facilities which have such equipment. He also introduces the MICROPROCESSOR to his BMET students to accommodate the surge of automated instruments - like the blood analyzer - based on microprocessor control.

One of the more gratifying features of this operational BMET (1:2 years) is that it has evolved into the kind of program already envisaged for the Philadelphia Regional Consortium of Biomedical Electronics Technology. Note the word ELECTRONICS: it is apparently preferred by Messers. Baker and Laskowski since it implies less restriction on the training of the program graduate than the word EQUIPMENT and tends to imply a broader scope of trained capabilities in the program graduate.

The academic core is relatively standard in electronics - copies are on file. Messers. Baker and Laskowski offered their continuing support in advising re BMET.

INTER-OFFICE CORRESPONDENCE

TO: Dr. Pietak, T. Hawk, Dr. Oates, and T. Raftery

DATE: June 4, 1979

FROM: Dr. W. F. Mruk

SUBJECT: Site-visit to Springfield Community College, Springfield, Mass. Re BMET Special Project #7750

Doug Fenwick and I visited with Mr. Ken DuPont and Mr. Ross Higgins of the Springfield Technical Community College. Here, the BMET Program maintains its own sovereignty amid an Electronics Program structured as a separate department. A cooperative interchange of instructors exists among these departments, especially in core or introductory courses. The BMET sovereignty is accounted for by the fact that the department is strongly active in the placement efforts of its graduates - an activity which has the effect of positive feedback on the BMET Program.

The department philosophy seems to focus on training students for the job market of medical equipment manufactures and service groups.

The program has been in existence for eleven years and graduates approximately 15/18 students per year and has placed essentially all of its graduates. (This year's graduates have commanded salaries from $13K to $17K!)

The program, furthermore, has addressed itself to the problem of mainstreaming by designing its facility around table-height lab. benches; in fact, the department assistant, Mr. Ross Higgins, is not only a graduate of the program, but also is wheelchair-confined. He operates the four labs on an open schedule of 8 hours per day - the results of this modus operandi have been to stimulate a comaraderie among the students who tend to be persons with a high sense of dedication to help others.

The laboratory medical equipment has been selected to illustrate how transducers operate in the measurement of physiological parameters, rather than for their newness, or latest development stage. (This approach is in concert with that of Monroe County Community College - the first site-visit, and makes good sense to this writer.)

Continued -

What appeared to be in conflict (to the writer) with the department's philosophy of developing the Analysis talents of its students was the requirement for the completion of a project - essentially tasks requiring Design capabilities.

The emphasis on transducer actions produced a pronounced "physics flavor" on much laboratory activity which was justified, probably rightly so, because trouble-shooting medical instrumentation systems requires an overview of many intersecting disciplines. (Our concept of a "magnet" or central "finishing" school in a consortium was greeted by loud huzzas as being "The Way to Go" - both, from the needs of the job market and those of the curriculum.)

There was no reference to clinical experience, although summer jobs tended to fill out this facet. (The department essentially has the students for at least two full semesters beyond the time for core requirements.)

This department is concerned with the wording in BMET, as in Monroe County Community College, to wit: Should "E" stand for EQUIPMENT OR ELECTRONICS? Again, the word, ELECTRONICS seems to give the graduates a wider acceptance in the job market.

Here, too, the academic core is relatively standard in electronics - copies of the core and BMET curricula are on file. Messers DuPont and Higgins offered their continuing support in advising us re BMET.

INTER-OFFICE CORRESPONDENCE

TO: Dr. R. Pietak

DATE: June 12, 1979

FROM: Dr. W. F. Mruk

SUBJECT: Site visit to Catonsville, Md., County Community College re BMET

Program director is John Walstrum; Assistant, John Schwartzman - program has been hurt by funding shortfalls.

This curriculum is strongly trouble-shooting oriented. It manages to scarf-up much used equipment, which the student's troubleshoot and update, or is cannibalized to support working units.

The BMET curriculum is offered as an option to the Electronics Program, and graduates approximately 10 students per year. Walstrum maintains a close rapport with tentative employers and serves as a job-hunters' clearing house. The curriculum stresses BMET as an ELECTRONICS discipline and is concerned mostly with instrumentation systems. The BMET graduates have experienced no difficulty in job placement. The course offerings are relatively standard in electronics.

INTER-OFFICE CORRESPONDENCE

TO: Dr. R. Pietak

DATE: June 12, 1979

FROM: Dr. W. F. Mruk

SUBJECT: Site visit to Jefferson University Hospital to review Biomedical Instrumentation Dept. on Tuesday, June 5, 1979.

Philip Katz, Ph.D., directs a thirteen-member Biomedical task force at Jefferson. This task force is involved with R & D, education, and the daily operation and administration of the hospital's in-house Biomedical Instrumentation Program. Thomas Jefferson Hospital exceeds the norm of 1 BMET per 150 beds. (Jefferson is a 700 bed complex.)

Perhaps the single overriding argument in favor of this department, particularly re continuous hospital operation, is the quick turn-around time afforded the hospital (10 minutes vs. 24 hours for a typical service contractor!) The only area in which his department doesn't participate at present is the C. A. T. Scanner.

The department does participate in R & D with the hospital as well as with Biomedical Equipment manufacturers.

Dr. Katz is totally in favor of a BMET program; insists that the emphasis of the curriculum be in basics (not defined) and strongly recommends a clinical experience of at least a six-months' duration.

Claims he could employ 1 or 3 BMET's immediately.

Willing to serve on our Advisory Committee and is active in many professional groups.

Has promised to send copies of:

(1) a typical feasibility study report re BMET

(2) name-list of Biomedical equipment manufacturers

(3) name-list of their professional group membership

(4) names of Advisory Committee

INTER-OFFICE CORRESPONDENCE

TO: Dr. Pietak

DATE: June 15, 1979

FROM: Dr. W. F. Mruk

SUBJECT: Site visit to Pennsylvania Hospital 8th and Spruce Sts., Re BMET

On Tuesday, June 12, 1979, Doug Fenwick and I visited the Pennsylvania Hospital at 8th and Spruce Sts., in Philadelphia. We met with Mr. Herbert Essex who is in charge, among other things, of medical instruments and hospital electrical safety and maintenance.

Presently, an al-factotum technician is the first contact for any in house service call. His assessment indicates whether the call can be satisfactorily handled from within or is rightfully an outside service call. Outside service calls are handled by service contracts, of which the hospital has a surfeit. In contrast with our information from Jefferson Hospital, Mr. Essex indicated that his turn-around time from his service contractors is two hours or less! (Cf. Jefferson's 24 hour outside and 10 minute in-house time). Among the service contractors are Honeywell, Space Labs., and Biotek.

Mr. Essex initially rejected the idea of an in-house BMET Department, but after reflecting on the description of what a BMET can do and at what price, he thought the idea had merit and pointed out that funds being what they are (everywhere), administration is looking hard at new programs and is presently involved in new construction. (We told him that graduates of our program wouldn't be available before 1981).

INTER-OFFICE CORRESPONDENCE

TO: Dr. R. Pietak

DATE: June 29, 1979

FROM: Dr. W. F. Mruk

SUBJECT: Site visit to Penn State Commonwealth extension Wilkes-Barre, Pa. to discuss BMET Program

The chairman and al-factotom for this program is Dr. John Gesink. Dr. Gesink is solely responsible for the program and is a dedicated and committed professor. The program boasts of a 4 credit clinical internship and, in terms of semester quarters, lasts for 8 quarters. In essence, the other Commonwealth branches of Penn State University Act as feeder schools to this program so that his entry class size is approximately 40 to 50 students. Filtering reduces this number to about 25 to 30 graduates - all of whom - so far - have found employment, primarily in hospitals. An inherent requirement for such a job hit-ratio is that the graduates accept the idea of going to the job wherever it may be located.

Dr. Gesink's feeder schools are a counterpart of our proposed consortium of community colleges. The feeder schools generally prepare the students in electronics fundamentals at their respective campuses (approx. 5 quarters). From them on, Dr. Gesink guides their development as BMET's. He admits that BMET's are people dedicated to serving others. (He himself is the archtype of this characteristic.) The labs are exceptionally well instrumented although the number of students assigned to a given lab. station can be as high as three.

Interpersonal Relationships are highly stressed at all times, but particularly during clinical experience. All-in-all, an exemplary program.

Educating the Handicapped in Biomedical Instrumentation

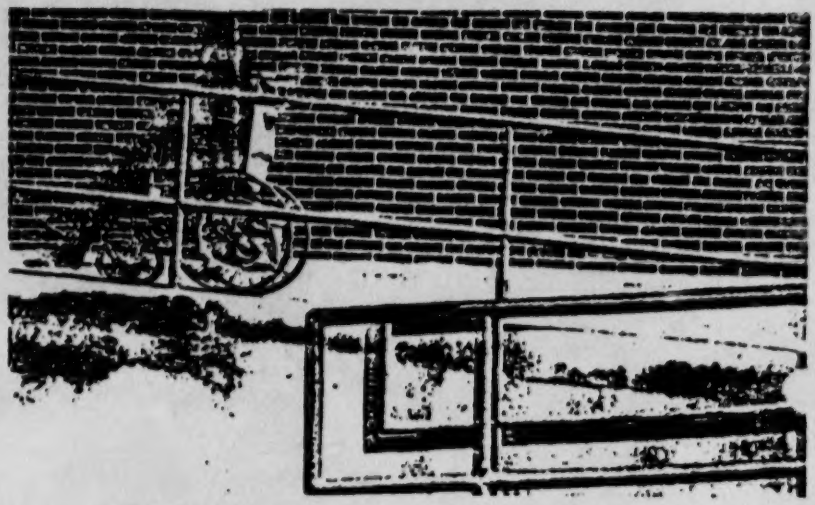
Gilbert M. Rosenbrier, Springfield Technical Community College

Dr. Rosenbrier is Dean of Academic Affairs at Springfield Technical Community College. He came to Springfield from the Massachusetts Board of Regional Community Colleges where he was Assistant to the President. While earning a doctorate from Boston University in Junior College Administration, he taught courses in systems theory and the history of college administration. Dr. Rosenbrier also has taught in the Boston Public Schools and has been a member of several commissions and committees appointed by the Governor of Massachusetts. These task forces focused on occupational education in the Commonwealth and on policies for making higher education more responsive to the needs of students in general and disadvantaged groups in particular.

EDUCATING THE HANDICAPPED IN BIOMEDICAL INSTRUMENTATION

Prepare persons with mobility impairments for productive technical careers. The barriers can be overcome.

For many years, the potential of the handicapped person has been ignored or underestimated. Talent has gone unused and underdeveloped. In September, 1971, Springfield Technical Community College (STCC) launched a program to make technical education available to the handicapped. We hoped to discover what alterations were needed in curriculum, facilities and support services to make it possible for handicapped persons to become more effective technicians.



WHY BIOMEDICAL INSTRUMENTATION

The Massachusetts Department of Education gave STCC a grant to create the pilot program. Upon reviewing our career programs to select the one most adaptable to the needs of handicapped persons, we determined that the biomedical equipment technology or "BMET" program was appropriate for several reasons. The BMET labs and classes are located on the same floor of one building, so they are easily accessible to wheel chair users. And many, if not most, of the graduating BMETs would be working in hospitals, which are generally designed without architectural barriers to handicapped persons.

Furthermore, there is an increasing number of satisfying jobs for graduates of BMET programs. BMETs are employed in health facilities, manufacturing firms, research institutions and military installations. They install, calibrate, operate, maintain and repair sophisticated biomedical equipment such as heart-lung machines, cardiac monitors, pH meters, electrocardiograms and automatic blood analyzers. ***If this equipment is not serviced precisely, diagnostic errors can lead to serious medical complications. Occasionally, electric shocks resulting from safety hazards have even led to the death of a patient.*** Since the national sales and use of biomedical equipment are increasing seven to ten percent annually, the need for competent, formally-educated specialists who can care for these instruments is growing each year. Within Massachusetts, this need has been stressed by an Arthur D. Little study.

RECRUITING HANDICAPPED PERSONS

In order to recruit students, we first submitted several articles to local newspapers. The reaction to these was disappointing. When we turned to *advertising* in local newspapers, we received a far more encouraging level of response. Three hundred twenty-five handicapped persons applied for admission to the program.

Because BMET requires knowledge and skills in both electronics and allied health fields, it was necessary to test applicants extensively. Those who had not completed their secondary educa-

tion were required to pass equivalency tests. Beyond this, all applicants were administered examinations in mathematics, physics, biology, electronics and chemistry. Twenty-eight applicants were then admitted to the one-year pilot program.

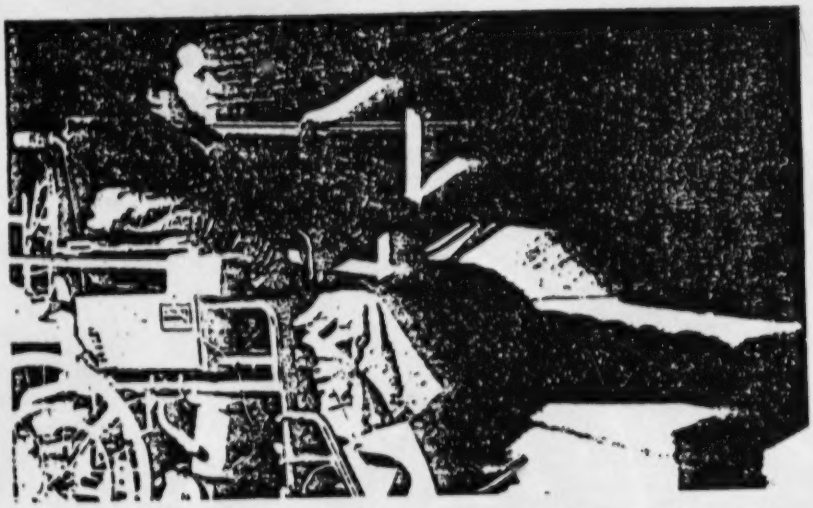
The grant from the Massachusetts Department of Education covered the cost of books, lab supplies, instructors' salaries and tuition. The Massachusetts Rehabilitation Commission provided housing for students who were living away from home. The Commission also continued its support of students who had previously received aid.

One of the program teaching assistants who provided a great deal of help with the pilot project was a wheelchair user himself, Ross Higgins. The year before, at the age of 43, Mr. Higgins had completed the regular BMET education program at Springfield, and was more aware than anyone else of the difficulties a wheelchair user must confront. He has been a quadraplegic since the age of 12, when he suffered an accidental gunshot wound. Before enrolling in the Springfield program, Mr. Higgins had explored many routes to furthering his education, but found most educational institutions unaware of or insensitive to the problems faced by the quadraplegic. ***Most important are the architectural barriers—such as a lack of ramps near stairways—which prevent handicapped persons from using facilities readily accessible to others.***

AVOIDING ARCHITECTURAL BARRIERS

At STCC we are fortunate that many architectural barriers to handicapped persons never existed or have been eliminated. Before the Technical Community College was established in 1967, many of the buildings which now comprise our campus were part of the Springfield Armory. The building in which the BMET program was conducted had been a munitions factory. Ramps, docks, and elevators were already installed, and well-adapted to our purposes. All buildings are connected by indoor passageways; thus, the library, cafeteria, rest rooms and other facilities could be made accessible to handicapped students.

Transportation arrangements are made for handicapped students who need them. Special parking spaces are allocated for students who drive their own cars. These spaces are located near "curbouts" or sidewalk ramps, adapted for use by wheelchair. Parking spaces for the handicapped are separated from one another by approximately four feet of pavement, to facilitate easier transfers from car to wheelchair. Springs have been removed from stall doors in rest rooms, to make these facilities more accessible to wheelchair users. As an outgrowth of the program, access symbols—signs designating areas which are convenient for wheelchair users—are scheduled to be installed.



INTERNATIONAL SYMBOL OF ACCESS FOR THE HANDICAPPED
For display on public buildings, hotels, motels, theaters, restaurants, stores, parking lots, and transportation facilities which are fully accessible to wheelchair users and other persons with limited mobility.

PREPARING THE CURRICULUM AND FACULTY

We found that our regular Biomedical Equipment Technology curriculum required no essential changes to accommodate handicapped students. No remedial or "special" courses were required. The regular program was, however, augmented in several respects. For example, handicapped students were issued tape recorders, with which they could record their lectures for play-back at home. These were purchased with funds from the original grant and were later supplemented by a series of pre-recorded lectures in several subjects. Tape recorders were used not because of any need for remedial materials, but because of the intensity of the study load. Taped materials

Educating the Handicapped in Biomedical Instrumentatio.

allow a student to proceed with course work at his own speed. The use of such taped modules, incidentally, has now been adopted for use throughout the campus by all students.

Faculty members held seminars concerning the special teaching needs of the handicapped. Experts conducted lectures and discussions on the nature of various handicaps and diseases. The psychodynamics of a non-handicapped teacher working with handicapped students were also explored. The faculty were thus given the background necessary to serve the aspirations of the handicapped more effectively.

We found at Springfield that most of the adjustments necessary in the pilot program were physical, rather than academic or psychological in nature. The problem is a physical one, with a physical remedy. As Ross Higgins has said, "If you decide you are going to provide a handicapped person with an education, it makes no difference how good your intentions are, or how much of a genius the potential student is, if he can't get into the school building. This isn't a matter of changing course content, or of lowering course standards. ***The issue here is simply this: How do we make quality course material accessible to those who have been excluded–because of physical handicaps–in the past?***"

SUCCESS OF PROGRAM

Of the twenty-eight who entered the one-year pilot program, over one-fifth were placed in BMET positions upon graduation. Another fifth acquired employment in non-BMET positions. One graduate began his own consulting firm. An additional forty percent decided to continue their BMET education at STCC as candidates for the Associate in Science degree. The remaining students left the program because of illness or for other personal reasons.

To assist our handicapped students in becoming accustomed to a new college environment, a larger program of services has been developed. Employing a staff of three, the Special Services department makes an effort to work with students who need counseling, orientation, or virtually any other form of special assistance. While it was specifically designed to acquaint handicapped and disadvantaged students with their new envrionment, this department can assist any student at STCC who has a special problem. It operates both as a clearinghouse for program information and as a planning forum for administration, faculty and students in such areas as financial aid, psychological problems, and work-study programs. Special Services integrates all the college's services for the benefit of each student's personal development.

These new college-wide services were, to a large extent, made possible by our experiences with the BMET pilot program. Many of these services have been implemented with the help of Ross Higgins. After joining our staff, Ross worked to strengthen the lines of communication among handicapped students, faculty and administration at STCC. According to Ross Higgins, "the real problem is that we are all members of some kind of minority. ***We all have handicaps. Some are visible, and some are not so visible. Nobody likes to look at a man in a wheelchair because that makes him aware of his own frailty. My job is to help so-called 'normal' people become more comfortable with this fact.*** The end result, I hope, is that people can eventually look at one another in terms of what they are capable of, and not concentrate so much upon the limitations a lot of people show in an unfavorable environment."

FUTURE PLANS

At STCC, we are now in the final planning stages of a short-term keypunch training program for paraplegics. We are also exploring the possibility of a new program for deaf students. This area will receive high priority in our future planning, for many applicants to the original BMET pilot program were deaf. They could not be accepted because we were not yet prepared to assume the added responsibilities of teaching the deaf. Many deaf applicants were college graduates. This indicates the extent to which their needs have been ignored. Their problems will receive our immediate consideration when we plan new programs.

STCC President Edmond P. Garvey's personal concern for handicapped people made the pilot program possible. The expert supervision provided by Kenneth DuPont as director of this pilot program was invaluable. Many other faculty and administration personnel contributed time and personal involvement. But the program's success was due primarily to the ability and determination of the handicapped students themselves. These students proved that when physical barriers are removed, educational and career fulfillment become possible.

FOR FURTHER INFORMATION:

David A. Lochwing, "Best of Health: Biomedical Technology -All Systems are Go," Barron's, November 5, 1973.

Arthur D. Little, Inc., Fostering Industrial Growth in Massachusetts, Vol. II: Strategies in Development of Selected Industries in the 1970s (Cambridge, Massachusetts: Arthur D. Little, October, 1970), pp. 65-67.

by Gilbert M. Rosenbrier

APPENDIX III
BIOMEDICAL EQUIPMENT TECHNOLOGY PROGRAM FEASIBILITY SURVEY

The Biomedical Equipment Technician (BMET) is a technician who maintains, repairs, calibrates, and trouble shoots medical equipment. A BMET is likely to be employed by either a hospital, equipment manufacturer, a contract maintenance firm, or any other facility concerned with the delivery of health care.

Directions: These questions were designed with brevity as a guideline. Please respond and return in the attached stamped envelope.

1. Do you feel there is a need for the Biomedical Equipment Technician? Yes 39 No 2

2. From the brief description above, at what level in your opinion, should a Biomedical Equipment Technician program be developed?

High School	4	Private trade school	2
Vocational-Tech. School	12	On the job training	7
Community College	31	No training	0
Senior College	9	Other (Please specify)	1

CE or BMET Certification program of study by military

3. How important do you consider to be the following General topics of study for the Biomedical Equipment Technician?

	Essential	Not Essential But Desirable	Not Essential
Biology	(20)	(17)	(4)
Business	(6)	(23)	(13)
Communications (oral & written)	(30)	(5)	(2)
Government	(6)	(16)	(21)
Mathematics	(33)	(6)	(-)
Medical terminology	(34)	(3)	(-)
Physics	(35)	(3)	(-)
Professional ethics	(24)	(11)	(3)
Chemistry	(18)	(22)	(1)

Please list other general topics you feel are essential. TORTS AND PRODUCT LIABILITY LAW, TROUBLE-SHOOTING, ANATOMY, PHYSIOLOGY, USE OF PROCESSOR, HEALTH CARE ORIENTATION, MECHANICS, ELECTRO MECHANICAL SYSTEM AND APPLICATIONS,*

4. How important do you consider to be the following Technical topics of study for the Biomedical Equipment Technician?

	Essential	Not Essential But Desirable	Not Essential
Analog Control Systems	(23)	(13)	(1) = 37
Computer Techniques (Familiarity)	(23)	(15)	(1) = 39
D.C. and A.C. Circuits (Programming)	(35)	(5)	(-) = 40
Electro-mechanical Systems Analysis	(33)	(2)	(-) = 35
Electronics Circuit Analysis	(35)	(3)	(-) = 38
Instrumentation Systems	(34)	(2)	(-) = 36
Physiological Transducers	(34)	(2)	(-) = 36
Electrical Safety	(34)	(2)	(-) = 36
Error accumulation & Reliability in Measurement Systems	(27)	(9)	(2) = 38

*AND BASIC TOOLS AND TEST REQUIREMENT.

Patient relationships	(17)	(14)	(4) = 35
Prescription interpretation	(4)	(12)	(20) = 36
Professional Relationships with with health care professionals	(23)	(10)	(3) = 36

Please list other technical topics you feel are essential to the BMET.

5. Would you be willing to serve in an advisory capacity to such a program?

   Yes 26 No 13

   If your answer to question (1) is yes,

6. Which of the following represents your projected outlook for the Biomedical Equipment Technician through the mid-1980's?
   - Increased job openings are anticipated due to developments in electronic technology. Yes 33 No 5* (*no response)
   - Some openings will arise from the need to replace experienced workers who retire, die or transfer to other occupations. Yes 18 No 5 13*
   - Job openings are expected to decline. Yes 1 No 21 13* (*no response)

7. Are you currently responsible for staffing a hospital, equipment manufacturing firm, biomedical equipment contract maintenance firm or a health care facility within the Southeastern Pennsylvania Region.

   Yes 35 No 2* (* no response)

   NOTE: If your answer to question seven above is yes, please answer the following questions. If your answer to question seven above is no, please stop here and return the form in the envelope provided.

8. Do you currently employ Biomedical Equipment Technicians?

   Yes 23 How many? 50 No 14 3* (*no response)

9. What is the Academic and/or level of training you required of your Biomedical Equipment Technicians at the entry level?
   (Please indicate an approximate number in each category to correspond with number 8 above.)

Program in high school	12	Private trade school	3 part-time
Vocational-Tech school	18	On the job training	3
Community college	8	No training	-
Senior college	18	Other (specify)	1 military

10. How many Biomedical Equipment Technician openings do you have each year due to turn-over?

    Number 8

11. How many Biomedical Equipment Technician openings do you anticipate due to growth of hospital or firm in:

    1981? 32
    1982? 24
    1983? 33
    (10 no response)

12. How many Biomedical Equipment Technician positions do you plan to terminate in:

1981? 0
1982? 0
1983? 0

13. What hourly wage range would you anticipate paying a beginning Biomedical Equipment Technician presently?

$6.54 (6,000.) to $7.86 average (23,000.)

14. If a program for Biomedical Equipment Technician were implemented at a community college in the Southeastern Pennsylvania Region, would you consider employing a graduate or graduates in 1981 or later?

YES 28 NO 1 7*
(* no response)

15. Would you kindly include any comments you feel may be of help in this survey. Thank you.

Comments: (A random sampling of comments, follows)

. . . . As you are no doubt aware, the growing number of regulations mandated by the state, Joint Commission on the Accreditation of Hospitals, and the insurance industry make it an absolute necessity that all hospitals establish and maintain a comprehensive bio-medical inspection, certification and training program. Finding qualified people to operate these programs has and continues to be a problem and thus the market for such personnel is there . . .#34

. . . . Somewhere in the program the concept of the consequence of error and/or sins of omission must be ingrained in the ethical standards of such technicians. . .#74

. . . . As a BMET he should have at least a year of hospital experience behind him. . .#19

. . . . Give students some exposure to the hospital environment prior to graduation. This could be made part of the program, I feel it can be invaluable to a student. . .#47

. . . . The training program you are suggesting is very much needed. It is very difficult to find qualified technicians. . .#6

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